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Innovativeness of national regulatory authorities in EU telecommunications

Introduction

Integral part of an effective transition to competitive telecommunication markets has been the creation of National Regulatory Authorities (NRAs) in European Member States. Their task is to oversee and regulate interactions between incumbents and entrant firms, primarily ensuring fair access conditions to the network of the dominant firm. Despite the crucial role NRAs play in the regulatory setting of telecommunication markets (most regulated goods and services are non-tradable across borders, see e.g. Haucap/Kühling 2006), our understanding of the driving forces of national regulatory decisions is still limited. This article identifies these driving forces for the early or late adoption of a new regulatory product. With this identification, National Regulatory Authorities are classified as adopter group member according to their degree of innovativeness.

Which driving forces influence a particular early or late adoption? According to diffusion literature, new means spread along an s-shaped curve, covering successive groups of members on the basis of innovativeness over time. Starting with a small share of innovators, early and late majority follows accordingly. The last group covers the so-called laggards, being particular late in adopting a new concept (Rogers 1962, 2003). All adopter categories are defined by specific characteristics, so for example are innovators identified as having high financial liquidity, a high social status and a close interaction with other innovative members (see Rogers 1962:282). This idea can be applied to the national regulators in EU telecommunication regulation and their particular innovativeness (i.e. their point in time of adopting a new regulatory mean). To address the issue of key influences on the adoption time, an innovative method is applied. The method of fuzzy set Qualitative Comparative Analysis has been gaining recently in application and popularity (see e.g. Berg-Schlosser 2008, Schneider/Wagemann 2012) due its verifiable inclusion of qualitative and quantitative research elements for systematic comparisons.

This article is organized as follows: After a presentation of three key regulatory innovations (section 1), potential influences on regulatory innovativeness of NRAs are identified (section 2). In section 3, the applied method is presented.

Moreover, some preparation of the data is done for later analysis. In particular the calibration of conditions and the outcome is given attention. The later includes a procedure, which allocates the national regulatory authorities to the four adopter groups, known from diffusion literature. In the following section 4, the first part of the empirical analysis follows. This includes the identification of so-called ideal types, revealing particular structures in the data. Further, necessary and sufficient conditions for high and low regulatory innovativeness are analyzed. Section 5 includes the second part of the analysis. Here, the results for the four adopter groups are evaluated more in-depth. The article closes with a conclusive summary, including limitations and policy recommendations (section 6).

1. Regulatory Innovations in EU telecommunications

Which regulatory products are good reflections for the level of innovativeness of national regulators? Most national regulators across Europe followed a regulatory approach based on the so-called “ladder of investment” concept, introduced by Cave and Vogelsang (2003).¹ The “steps” of the ladder include (in this order) resale (or wholesale line rental), bitstream access and local loop unbundling obligations. The introduction of these different access regulations is considered as crucial regulatory innovations to enforce competition in the markets.

Wholesale line rental (in short: **WLR**)² enables competitors to both line rental and calls to end-users over the incumbent’s local network.³ Typically, this includes that the final customer is billed by the wholesale line rental provider and has no longer a contractual relationship with the incumbent. The adoption process of wholesale line rental started later and less intense compared with the adoption process of the other two access products (see figure 1).⁴ In the updated regulatory EU framework for electronic communication services, introduced in 2002, Art. 12 sect. 1d of the Access Directive explicitly mentions the obligation “to provide specified services on a wholesale basis for resale by third parties”. The adoption rate seems to speed up afterward the publication of the EU Directive, but in a slow and steady speed.

In the case of bitstream access (in short: **BSA**), the copper pair spectrum is shared by the incumbent and the entrant. Incumbents remain in control and can still provide services to consumers. Typically, an incumbent provides ADSL technology and modems and entrants don’t have control over the physical line and are not allowed to

¹ According to this approach, regulators should encourage access to wholesale markets by fixing very low access prices, particularly for the network elements that are too expensive for new entrants to replicate. As soon as new entrants consolidate their market positions, authorities should increase access prices to these network elements in order to encourage entrants to invest and to create gradually their own infrastructure, to move up the ladder of investment in the industry jargon (Mananti/Sciala 2011).

² The concept is also known as “Resale” (Germany), “Resale of Land Line Services” (Denmark) or “Resale of Subscription” (Norway).

³ Weber (2004) defines WLR as the bundle of services which an incumbent fixed operator offers to his retail subscribers in connection with access to his voice telephony network covered by subscriber’s payment of a monthly line rental and which is made available to alternative communication service providers on a wholesale basis.

⁴ First mover was the Danish NRA, which introduced WLR in 1999. The incumbent TeleDanmark began offering WLR services at the end of 1999. The national regulator did not introduce an incentive-based regime or any other relaxation of retail price control to alleviate the introduction of WLR. Nevertheless, the uptake in the market went quickly and has been evaluated as success (Neumann 2004:32f).

add other equipment. Therefore, entrants are restricted to supply services designated by the incumbent.⁵ Compared to WLR, in the case of bitstream access, the adoption curve is steeper at the beginning. The adoption process starts later, but proceeds quicker over time (figure 1). The European level was cautious with its interventions on BSA. In fact, solely the ERG adopted a common position on the product in April 2004, after an extensive consolidation of its members.⁶

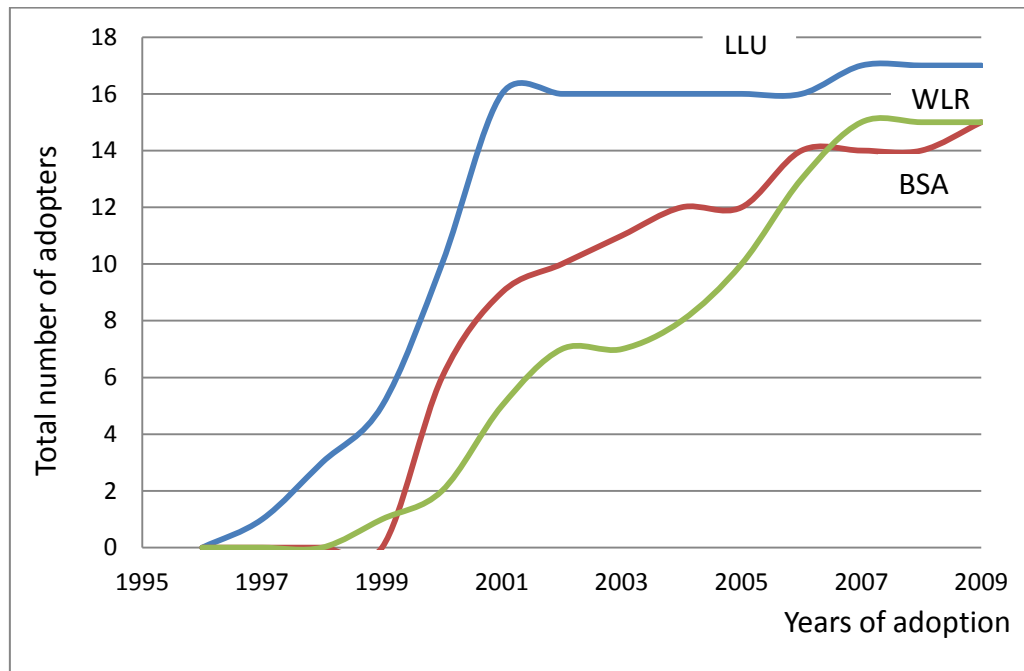


Figure 1. Spread of three wholesale access obligations across Europe and time

Local loop unbundling (in short: **LLU**) requires the highest level of investment by entrants. To offer voice services, competitors to traditional incumbents traditionally need the mean of full LLU⁷ to obtain full control of the copper pair. This access mean implicates that competitors have to build a core network down to the local exchange of the incumbent, and to install their own broadband equipment.⁸ This gives entrants more control over the types and quality of services, they provide to the end-users.⁹ End of 2000, the European Union intervened heavily by setting out a regulation on unbundled access to the local loop¹⁰. Not surprisingly, the European Regulation speeded up the adoption of LLU by the National Regulators

⁵ See de Bijl/Peitz (2005:36).

⁶ The common position can be found here:

http://www.berec.europa.eu/doc/whatsnew/erg_0333rev1_bitstream_access_common_position.pdf. Beside this document also e.g. the COCOM commented on BSA (COCOM03-04Rev1).

⁷ LLU comes in two types. With “full” unbundling, entrants rent the copper line as a whole, whereas “shared” unbundling includes only the rent of the upper bandwidth of a line. Since we are only interested in the first introduction of a remedy, we ignore the option of “shared” unbundling in our analyses.

⁸ This is the installation of a Digital Subscriber Line Access Multiplexers (in short: DSLAM) in the incumbent’s local exchanges; see Bacache et al. (2013:4f).

⁹ For Local Loop Unbundling, the first mover was Finland, which introduced LLU in January 1997. In fact it was not the finish regulator FICORA, but by the Ministry of Transport and Communications of Finland, who introduced the mean.

¹⁰ Regulation of the European Parliament and of the Council on unbundled access to the local loop, No 2887/2000, published on 18th December 2000. The Regulation was a consequence of formerly unsuccessful approaches by the EU Commission to increase the number of unbundled telecommunication lines in Europe, see Weber 2004: 6f. For more details see Gallo/Pontarollo (2005:12f).

The majority of the 17 European countries under investigation have progressively adopted the three access obligations WLR, BSA and LLU. Despite a tendency of convergence of regulatory pattern in access policies across Europe, it has become clear, that NRAs across Europe have diverged in their approach and their degree of commitment to implement access obligations (OECD 2008).

2. Theoretical Accounts: Influencing factors on Regulatory Innovativeness in EU telecoms

The sector of telecommunication has been the most dynamic among European network sectors in terms of market development. Crucial for this progress is the institutional regulatory framework set by European, but also by national regulators. But which factors have influence on the relative early or late point in time, when a national regulator adopts a new regulatory policy?

Most notably, characteristics of national regulators require careful attention. First, the success or high **institutional quality** of a national regulator is assumed to have strong influence on the national adoption decision (Rogers 1995; Bouche, Volden 2011). A particular well-performing regulator in utility industries is typically characterized by elements such as high level of independence, transparency of regulatory decisions or accountability of the regulator for its decisions among other institutional arrangements (e.g. Mustafa 2002).¹¹ In case, that the national regulator shows a high level of independence, a positive impact on regulated firms' investment can be found (Cambini/Rondi 2011). In case, that a NRA has according resources and operates transparently, the earlier introduction of a new regulatory mean should be easier. As outlined in expert interviews, the influence of the institutional environment is considered as a particular important element of regulatory innovativeness and therefore decisive for the introduction date of regulatory mean. A good performance of a national regulator is closely related with the idea of imitation as underlying diffusion mechanism, focusing on other NRAs than the potential adopting one. States aiming to improve their own performance and institutional quality are more likely to imitate states that have a better track record than they do (Shipan/Volden 2014:368).

Moreover, the **size and wealth** of a national regulator and its national environment seems to be important. In economic literature, the size of firm is typically positively correlated with the degree of innovations (Fritsch 2014:191f). With increasing manpower, also a regulatory authority may be able to come up with more diverse creative ideas to improve the institutional regulatory setting in a country. In diffusion

¹¹ Empirically, the chosen approaches differ widely and there is a general positive finding that better regulatory quality leads to higher industry performance (Edwards/Waverman 2006:27). Most studies correctly tackle the issue of potential endogeneity of regulatory governance measures, since there is a strong likelihood that these measures are correlated with unobserved variables, which again are correlated with industry performance, i.e. countries are more likely to adopt effective regulatory agencies the more they have a positive attitude to the commercialization of economic activities, to private investment and so on. Therefore, these regulators (and their performance) cannot assumed to be exogenous. (Edwards/Waverman 2010, Waverman/Koutroumpis 2011); Review can be found in Stern/Cubbin 2003:29.

literature, larger and wealthier states or institutions are more likely to be seen as leaders (Walker 1969). Early adopters of an innovation are therefore assumed to control substantial financial resources in contrast to late adopters. Implementation of new access means in less wealthier countries is accordingly expected to be later. Smaller Member States and their national regulators may want to appear similar to larger and wealthier ones to raise their profile. Another underlying reasoning for early or late adoption of a regulatory policy may be the (dis-) similarity of countries or national regulators. In case that there are ideological or political similarities an effect on the spread of policies can be expected (e.g. Grossback et al. 2004).

Rogers (1962) stresses the point that social learning will positively affect all adopter groups, due to the idea that innovators have strong social ties. This is assumed to be transferable to national regulatory agencies in Europe. In case that national regulators are active in certain groups or regulatory networks for a long time period, this might positively affect their probability of early remedy adoption. Therefore, the **membership to certain groups** is assumed to have influence on the timing of a national adoption decision. Communication via pan-national organizations or EU-wide scientific discourse may channel knowledge or best practices in a certain area. In the sector of telecommunication, the two important regulatory groups or networks are the Independent Regulators Group (IRG) and the European Regulators Group (ERG) ¹², which turned into the Board of European Regulators for electronic communication (BEREC) in 2009. Whereas the IRG has been established in 1997 by a group of EU National Telco Regulators to share experiences, the ERG has been set up by the EU Commission in a 1999s Communications Review to enhance officially the co-ordination between national regulatory decisions in the sector. Despite differences in set-up and members, both regulatory groups can be assumed to enhance communication between its members and to positively influence the innovative potential of its members and separate NRAs from traditional administrative apparatus (Egeberg 2006).

Moreover, the **competitive** market situation in a country requires attention. Under consideration of competitive pressure by alternative operators, i.e. cable providers, national regulators have to evaluate their access decisions in terms of whether they promote the rolling out of parallel, competing infrastructure or whether they further competition in a single network with regulated access. Experiences from telecommunications deregulation and regulation show that in the past regulators have often tried to establish frameworks enabling both forms of competition (Picot, Wernicke 2007:661). Given the respective market situation, a national regulator decides on the optimal point of adoption of a mean, allowing an increased level of service-based competition on regulated terms. The respective market situation is therefore crucial for the regulators inherent innovativeness. As outlined in former

¹²Decision 2002/627/EC established the European Regulators Group (ERG) for Electronic Communications Networks and Services. Since, the role of the ERG was evaluated as too weak, ERG has been by the Board of European Regulators for Communication (BEREC) in 2009. Both act as an exclusive forum for cooperation among NRAs and the Commission. More information can be found here XXX.

literature (Lemstra et al 2014), where strong infrastructure-based competition, typically from cable, is in place, market shares for access based competition are lower. Therefore, in countries with relative low cable coverage an earlier introduction of access obligations can be expected. However, on the eve of full liberalisation on 1 January 1998, nearly 60% of cable customers were served by a cable operator wholly or partly owned by the local telecommunications incumbent (Ungerer 2000:25). Thus, high cable coverage is not necessarily an argument for high infrastructure-based competition. Overall, the supplier structure in EU member states is highly heterogeneous and big inter-country differences can be found. Therefore, the chosen strategy of a national regulator is important and cable coverage may be only one element to be considered.

Last, but not least, the respective innovativeness and allocation of regulators in adopter groups may be determined by the regulatory environment outside the country. In the EU regulatory system, national policies are often transferred through economic or political linkage between member states. This linkage creates pressure to modify policies to improve national competitiveness. It can therefore be assumed, that regulatory competition creates incentives to adopt innovative measures at an early stage to gain “first mover advantages” (Porter, van der Linde 1995). To avoid adjustment costs, national policy makers may be forced by considerations of competitiveness to adopt the innovative policy measures of Pioneers (Heritier et al 1996).¹³ Therefore, the influence of **European level activities** on the according national decision to adopt a regulatory mean must be included as impact factor for the national introduction date of a new regulatory product.

3. Method and empirical approach

For the identification of the influencing factors on the innovativeness of national regulators, expressed in their adoption date of a regulatory mean, case studies of all countries under investigation with a focus on these influences have been performed. Since the background covers diffusion, telecommunication and institutional regulation literature, respective sources are included.

Furthermore, a brief survey was sent to each of the regulatory authorities, asking them for the respective date of adoption of an access obligation and their number of employees. The date of introduction was captured from their responses, considering the date of the respective regulatory decree, imposing an obligation. Missing data was filled up by data, gathered by Cullen International. Moreover for data on the market and NRA characteristics further sources were used.¹⁴ Additional, interviews

¹³ Another reason for relative early policy adoption may be legitimacy pressures from the promotion of policy models by pan-national institutions (Knill, Holzinger 2005). Member states compete for resources, but also for verifying their legitimacy as members of the EU community. Policy convergence is then not result of problem-solving approaches. Often, pan-national institutions promote policy convergence by encouraging spread of distinctive policy approaches, considered particularly promising. Cross-national policy transfer is therewith stimulated by (non-binding) common goals and standards, national policies should aim at through an internationalized peer review and respective benchmarking (e.g. Humphreys 2002:54).

¹⁴ Sources covered ITU/OECD databases, ETCA documents and information on the homepage of the regulators.

with representatives from national regulatory authorities and market experts provided further background information. Table 1 in the appendix provides an overview on the raw data on the Interval Scaled Conditions, Characteristics of Qualitative Conditions in short and respective sources.

Since the primary interest is in identifying influences on regulatory innovativeness, it seems helpful to employ traditional econometric analysis. However, the data is limited to 17 European countries and therefore 17 national regulators, which are comparable in terms of their market situation and national development. Therefore, the so called small sample problem¹⁵ is present and prevents the valid application of those methods. Pure qualitative methods on the other hand are often not able to include the overall picture.

One approach to combine variable-oriented methods, such as statistical analysis and case-oriented approaches in a nested analysis is the comparative method, introduced by Ragin (1987) (Rohlfing 2008). This method allows examining the holistic value of each individual observation, but also the comparison of multiple cases. In contrast to most qualitative methods, it is an analytic approach, which allows replication (Berg-Schlosser et al. 2009). Furthermore, is not radically analytic, as it leaves some room for the integral dimension of phenomena (Rihoux et al 2011). The comparative method uses Boolean algebra to simplify complex data structures in a logical manner. Therefore a data table, which displays a specific combination of conditions and an outcome, is reduced by using Boolean algebra to the shortest possible expression to unveil regularities in the data. It is then up to the researcher to interpret this minimal formula, possibly in terms of causality (Rihoux et al 2011:14). The comparative method has been applied in similar context, e.g. for an investigation on the spread of the Flat Tax in Eastern Europe (Evans/Aligica 2008). However, there are limitations one has to be aware, when using this methodological technique. First, choice of influential factors is done by the researcher on the basis of given literature. Possibly important factors of influence may be missing. Second, since the dichotomous values present simplified reality, setting is explorative and the values are no probabilities, the results must be interpreted very carefully. Third problem of the comparative method is the lack of some rules of good practice, since it is a relatively new methodological tool. The clear presentation of analytical findings in a formally correct, theoretically clear way is challenging (Schneider/Wagemann 2010:18f). In the following, the vocabulary developed in the context of this method is used to avoid misunderstandings.¹⁶

¹⁵ In general, when we use a given sample to estimate a continuous relationship, a sample with size $n < 30$ can be regarded as a small sample (Huang, 2002:2).

¹⁶ Term "condition" is used, not "independent variable;"; phenomenon to be explained is called "outcome," not "dependent variable;" use of this vocabulary is not only more correct formally but also diminishes the risk of confusing the underlying logic of the comparative method with that of other data analysis techniques, such as regression analysis, which might look similar on the surface, but are based on different mathematical procedures and epistemologies (Schneider/Wagemann, 2010:8); a distinction between regression models and the comparative method can be found in Schneider/Wagemann, 2007:77ff. A Glossary can be found in the appendix of this paper.

The comparative method requires included cases to be similar to some respects. Under consideration of the enlargement of the EU over time, the analysis includes the EU-15 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom) plus Norway and Switzerland, as these countries show a similar economic and institutional situation and the regulators are installed in the same time period.¹⁷ The time covers the years starting from 1997 (first introduction of one of the three means) until 2014.

Under a qualitative comparative strategy, cases are seen as configurations of their features and the outcome. Combinations of conditions are expected to affect the outcome (Freitag/Schlicht 2009:56). Since for the application of Fuzzy Set Qualitative Comparative Analysis, a set-theoretic view applies, membership of a group is used to define whether a case can be described by a concept or not (Schneider/Wagemann 2012:24). This process of assigning set membership is called “calibration”.¹⁸ Calibration of explanatory conditions and the outcome depends on the basic assumptions about set memberships in Boolean and Fuzzy logic (Ragin 2000). Membership of each case in a set of conditions may vary between full membership (value 1) and non-membership (value 0). The value 0.5 is the crossover point, indicating border between cases that could be “in” or “out” of a set.

The transformation of the interval scaled values (table 1 appendix) into a fuzzy-value scale (table 2) among the qualitative anchors (table 3) was undertaken using Ragin`s (2008:89ff) direct method of calibration¹⁹. The selection of the qualitative anchors (table 3) is theoretically based. For all four conditions, considered for fuzzy-analysis, there is no universal criterion that defines full membership, crossover point or full non-membership. Obvious value breaks among the cases are also used to set the qualitative thresholds. The coding of conditions refers to the occurrence of the outcome of “high/low regulatory innovativeness”. As a consequence, the membership of a case in a set of conditions describes the determinate that is assumed to produce high regulatory innovativeness, while non-membership is taken as producing low regulatory innovativeness.

¹⁷ Older (EU-15) member states tend to have higher levels of broadband availability and take-up, as well as higher speed offerings (with some exceptions, notably Ireland and Greece, having relatively low levels of access and use) (see Preston 2007). NRAs in the EU-15 have been set up after 1990s, after strong EU encouragement (Recital 29 and Article 7 of Commission Directive 90/388/EEC of 28 June 1990 on competition in the markets for telecommunications services).

¹⁸ In contrast to “crisp-set”-calibration (“dichotomization”), “fuzzy-set”-calibration preserve the capability of establishing difference-in-kind between cases and add to this the ability to establish difference-in-degree between qualitatively identical cases (Schneider/Wagemann 2012:27). A partial membership is therefore valid. Furthermore, cases can be more in than out of a set (Ragin 2000:156). Similar to natural science approaches, calibration is not only the linear transformation of data on the interval between 0 and 1. Rather calibration is done by the use of external criteria (Schneider/Wagemann 2007:108f).

¹⁹ The procedure to transform raw data into a fuzzy table is the following: After the assignment of thresholds for full membership, full non-membership and cross-over point, scores are translated into the metric of log odds. Membership scores are calculated with the formula (degree membership= $\exp(\log \text{ odds}) / 1 + \exp(\log \text{ odds})$), where \exp is the exponentiation of the log odds to simple odds. Therewith measures range from 0 to 1 and are tied to their respective membership threshold and crossover point. A detailed description of the procedure is done in Ragin 2008:85ff. The values of this paper are accomplished with the compute command using the software package fsQCA (see Ragin, Drass and Davey 2007).

3.1 Conditions included and their calibration

Based on the theoretical assumptions, outlined in chapter 2, five conditions are included, which are outlined below.

Institutional quality How to measure institutional quality of a NRA? Beyond the use of dummy variables to include regulatory independence (e.g. Gutierrez/Berg 2000, Fink et al. 2002, Ros 2003), more detailed indexes of regulatory governance and independence elements have been constructed to measure institutional quality (e.g. Gual/Trillas 2004). A sophisticated version of an institutional quality index of national telecommunication regulators in 142 countries is presented by Waverman/Koutroumpis in 2011. The final index covers four main elements: 1) Regulatory transparency, 2) Independence, 3) Resource availability and 4) Enforcement on licenses (for more details see Waverman/Koutroumpis 2011:454ff). This index, reporting on the institutional quality of the national regulator is included as first element of this analysis for the identification of its potential influence on regulatory innovativeness.

For this category, the institutional quality index of national regulators shows one bigger gap in the data. Luxembourg shows with 0.49 a particular weak relative institutional quality. Therefore the lower level threshold is set at 0.49, indicating Luxembourg as non-member of the set of countries with high institutional quality in the field of regulation. France, Greece, the Netherlands, Portugal and Spain show the same institutional quality (0.58) and are therefore grouped together, setting the 0.5 threshold at 0.59. For the identification of the upper threshold, the primary paper of Waverman/Koutroumis (2009) was consulted again to identify further evidence on particular high institutional quality. Therewith, the upper-level threshold is set at 0.67.

Size The average number of employees of the national telecommunication regulator for the years 1999 to 2009 (where available) is included in the analysis. With a bigger size of an agency in terms of employees, it can be assumed that the factual autonomy of the regulator increases (Bach/Ruffing 2013:260) and therewith its flexibility to decides on the introduction of new measures.

In number of employees, the telecommunication regulator in the United Kingdom is by far the biggest compared to all other countries included in the sample (on average 641 employees). Therewith, this regulatory authority is clearly a full member in the set of big-sized national regulators. Second biggest regulator is in Switzerland with 301 employees. To include this relation, 400 is applied as upper-level threshold. On the other side of the range, Belgium with on average 27 employees and Italy with on average 37 employees can be found. Therefore the lower-level threshold is set at 40 employees. A quite large gap in the data can be found between 162 employees in Sweden and 239 employees in Germany. Therefore, the 0.5 crossover point is fixed at 210 employees on average.

Group National regulators in the sample that access IRG at a later stage are France (2008) and the Netherlands (2011). The more formal ERG includes representatives of independent regulatory authorities from twenty-five member states. In the sample, Norway and Switzerland are no member of the regulatory network.

The variable “group” was coded “0” when the agency was not a member of IRG or ERG, “1” if it was member of one group, “2” if the NRA was member of two groups. Since there was no case of a non-membership, the variable was re-coded to “0” in case of one membership and “1” in case of two memberships. Therefore, for the condition Group there are only the dichotomous characteristics “full-membership” and “non-membership”.

GDP The financial situation in a country and the role of relative wealth and respective budgetary pressure finds consideration in my analysis. With the average GDP per resident (mean over the years 1997-2009), a stable indicator of national relative wealth is used. This is included to distinguish between countries in their ability to introduce, pay for and maintain effective regulation (Waverman/Koutroumpis 2011: 455).

Among the 17 EU member countries included in the sample, it is Luxembourg showing by far the highest GDP per capita over time (63191 Euros on average). Therefore Luxembourg is coded 1 and is therefore full member of the set rich countries. According to empirical data, Norway also has a relatively high GDP/capita (45354 Euro on average). Therefore the upper qualitative threshold is set at 40000 Euro, according to general knowledge and gaps in the data. On the other hand, Greece and Portugal show a significantly lower GDP/capita over time, compared to all other countries of the sample (22500 Euro and 20902 Euro respectively). These countries are therefore non-members of the set rich countries (lower threshold is set at 2000 Euro). The threshold in the middle divides the countries into those, which are rather in the group of rich countries and those which are rather in the group on non-rich countries (Ragin 2006:10). Due to those consideration and given data structure, this threshold is set at 28000 (table 3).

Cable Moreover, the inclusion of cable coverage serves as a proxy for the infrastructure-based market competition. With the mean on the inclusion of cable modem internet subscriptions per capita over the years 1999 until 2009, the national competitive situation is covered.

For the calibration of the cable-based competition is the contextual situation relevant. Due to technical progress, data covers a time period, where broadband services provided via TV-cable were just evolving across Europe. Traditionally, particular the Netherlands have a high share of cable coverage from the very beginning of cable market development (OECD 2008; 0.08 mean cable subscriptions per capita). The upper threshold is therefore set at 0.08 and the Netherlands is considered to be a full member of the set countries with high cable coverage. On the other hand, Italy and Greece do not show any cable share until 2009 (ITU data). Therefore those countries are full non-members of the set countries with high cable coverage. The lower threshold is therefore set at 0. To divide the set into rather members and non-

members a threshold of 0.02 applies. While considering the relative population of an EU member state, 8 out of 17 countries in my sample developed in numbers over time, but cable subscriptions remained relatively low in total broadband coverage.

Cases	Institution	Size	Group	GDP/cap	Cable/cap	Yi
AT	0,68	0,06	1,00	0,75	0,73	0,67
BE	0,93	0,04	1,00	0,67	0,88	0,67
DK	0,95	0,72	1,00	0,72	0,88	1,00
FI	0,75	0,22	1,00	0,54	0,51	0,67
FR	0,42	0,25	0,00	0,58	0,18	0,67
DE	0,99	0,61	1,00	0,67	0,18	1,00
GR	0,42	0,16	1,00	0,04	0,05	0,33
IE	0,90	0,09	1,00	0,84	0,18	0,33
IT	0,49	0,05	1,00	0,45	0,05	0,67
LU	0,03	0,55	1,00	1,00	0,18	0,00
NL	0,42	0,10	0,00	0,82	0,95	0,33
NO	1,00	0,30	0,00	0,99	0,62	0,67
PT	0,42	0,22	1,00	0,01	0,73	0,33
ES	0,42	0,14	1,00	0,22	0,49	0,33
SWE	0,95	0,30	1,00	0,64	0,62	0,67
SWI	0,59	0,81	0,00	0,89	0,82	0,00
UK	0,90	1,00	1,00	0,67	0,73	0,67

Table 2. Fuzzy-Set Data Matrix, where Yi represents the set of innovative regulators, for more details on content and raw data see Table 8 in the appendix. Cases with fuzzy-values of 0.5 are according to theoretical knowledge recoded as 0.49 or 0.51 respectively. This is since the program fsQCA otherwise omits these values (e.g. Schneider/Wagemann 2007:180ff;191f).

Interval-Scaled Indicators of the conditions	Threshold Full Non-Membership	Crossover Point	Threshold Full Membership
High institutional quality of NRA	.50	.59	.67
Big size of a NRA in terms of employees	40	210	400
Wealthy country in terms of GDP per capita	23000	28000	40000
Country with high cable coverage per capita	0	2	8

Table 3. Three Qualitative Thresholds of four explanatory Indicators.

3.2 Calibration of the Outcome

For the classification of the national regulators according to their respective innovativeness (i.e. degree to which a regulator is relatively earlier in adopting new access regulations than others), a three-step procedure is applied.

First, the national regulators are sorted by the introduction date of LLU, WLR and BSA (table 8 in the appendix). In literature, the typical distribution on the diffusion curve covers 16% of Pioneers, 34% of Early Majority, 34% of Late Majority and again 16% of the Laggards (Rogers 1995, 2003). According to this allocation, the national regulators are grouped. Depending on the frequency of a national regulator to be in one of the groups, the regulators are brought into a chronological order on the right side of table 8. In case a national regulator is two or more times in a certain adopter group, this is reflected in the final membership in the set of Innovative Regulators. An overview of the allocation can be found in table 4. This assignment of a regulator to a degree of membership in the set of “Innovative Regulators” is called qualitative calibration strategy (Schneider/Wagemann 2012:38f).

Pioneers	Early Majority	Late Majority	Laggards
Denmark	Finland	Netherlands	Luxembourg
Germany	France	Portugal	Switzerland
	Austria	Greece	
	Sweden	Spain	
	Belgium	Ireland	
	Norway	Italy	
	United Kingdom		

Table 4. Adopter Groups of National Regulators.

According to the adopter groups of national regulators in table 4, the outcome is coded 1, 0.67, 0.33 and 0 respectively (table 8 in the appendix).²⁰ This coding is also assigned to table 2.

4. Analysis

4.1 Identifying Ideal Types

Table 5 presents the dichotomous truth table of the five conditions and their sufficiency for the outcome. Fuzzy scores higher than 0.5 are transformed to 1, fuzzy values below 0.5 are set as 0 (see e.g. Freitag/Schlicht 2009). Every row indicates the ideal types or vector space corners (Schneider/Wagemann 2007:97ff). The short-time dichotomization helps to spot commonalities and differences among cases. The dichotomous truth table underlines the empirical evidence of one extreme types of the fuzzy set vector space (row 2).

²⁰ This type of calibration is also applied by Emmenegger (2011).

The conjunction of the presence of all five conditions predicted to the outcome “high degree of regulatory innovativeness” (high institutional quality, big-sized regulator, which is member of the two groups ERG and IRG, wealthy country with high cable coverage) is the best-fitting ideal type for Denmark and the United Kingdom. The high outcome values in those cases (high regulatory innovativeness > 0.5 and therefore membership in the groups Pioneers and Early Majority) support assumptions made earlier.

Since the impact of the condition cable has been outlined as not being definite, the conjunction of the presence of all condition with exemption of cable also leads to the outcome “high degree of regulatory innovativeness”. This is the best-fitting ideal type for Germany. The high outcome values in those cases (high regulatory innovativeness > 0.5 and therefore membership in the group Pioneers) support again assumptions made earlier.

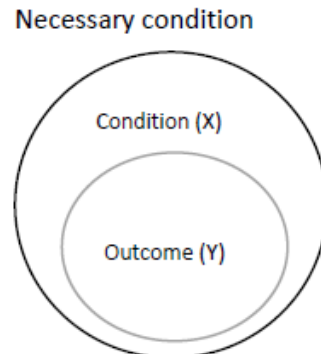
A (INST)	B (SIZE)	C (GROUP)	D (GDP)	E (CABLE)	Cases	Consistency of sufficiency for outcome high regulatory innovativeness ²¹	Consistency of sufficiency for outcome low regulatory innovativeness
1	0	1	1	1	4 (AT, BE, Fi, SWE)	0,99	0,53
1	1	1	1	1	2 (DK, UK)	0,99	0,51
1	1	1	1	0	1 (DE)	0,98	0,63
1	0	1	1	0	1 (IE)	0,84	0,70
0	0	1	0	0	3 (GR, IT, ES)	0,84	0,91
1	0	0	1	1	1 (NO)	0,80	0,79
0	0	1	0	1	1 (PT)	0,79	0,97
0	0	0	1	0	1 (FR)	0,78	0,69
0	1	1	1	0	1 (LU)	0,61	0,96
0	0	0	1	1	1 (NL)	0,54	1,00
1	1	0	1	1	1 (SWI)	0,50	1,00

Table 5. Dichotomous Truth Table including the Ideal Types, rows with no cases excluded. Note: The columns in boxes indicate the results are judged as consistently sufficient for the outcome.

²¹ As explained below more in detail, a sufficient condition is expressed as $X_i \leq Y_i$. In an X-Y-Plot therefore, most cases must be positioned above the diagonal. The respective consistencies of sufficiency for the two outcomes (high regulatory innovativeness or low regulatory innovativeness) are calculated by dividing the sum of the minimal values of X and Y of every case by the sum of the membership values of X, see Schneider/Wagemann 2007:203ff). If in every case, X is smaller than Y, this means that 1) Formula results 1, 2) all cases are above the diagonal in an X-Y-Plot and 3) a 100 per cent consistent sufficient condition is given (Schneider/Wagemann 2007:205). The values in boxes signal a consistency of sufficiency above 0.9 (this value is recommended in literature, see XX) for a respective outcome. Table 5 outlines, that for three ideal types (covering the cases Ireland, Norway and France) only a low consistency of sufficiency for the two outcomes can be found. These three cases are not included in the minimization process and are therefore not explained by the methodology applied.

4.2 Analysis of Necessary and Sufficient Conditions

In set-theory, the presence of a **necessary** condition requires the certain presence of a condition if the outcome occurs ($X \leftarrow Y$; see Schneider/Wagemann 2007:37).²² The following Venn-diagram displays this relation.



Following Schneider/Wagemann 2007:39.

In fuzzy logic terms, this implies that the values of the condition have to be equal or higher than the values of the outcome (Freitag/Schlicht 2009). The investigation of necessary conditions for the outcome 1 (“High regulatory innovativeness”) occurs with the conclusion that the presence of the conditions “High institutional quality” is consistently necessary for a high level of innovativeness of a regulator. The consistency value (see Ragin 2006) is above 0.9 for the case of high regulatory innovativeness as an outcome (consistency value 0.95).²³ Therefore, the analysis of necessary conditions for the outcome 1, “high regulatory innovativeness”, can be assumed to require a high institutional quality in a country. Since the index applied includes elements such as regulatory transparency, independence, resource availability and enforcement of licenses, positive values in these categories seems to push high regulatory innovativeness. Figure 2 shows the relationship graphically. For a condition to be necessary, all cases should be positioned around or below the bisecting line (Ragin 2000:215). In Figure 2, some cases are located next to, or even on the bisecting line, while two cases are clearly above the bisecting line (France and Italy). Others are clearly below the line. This means that while a high level of regulatory institutional quality is necessary for the presence of the outcome regulatory innovativeness, their presence is not sufficient. One country has a particular low regulatory innovativeness despite its high level of institutional quality (Switzerland). In contrast to all other EU countries included in the analysis, in Switzerland, no “ex-ante” regulation exists, but an “ex-post” regulation prevails. There, the incumbent Swisscom provides a basis offer for all wholesale services, which are regulated. In case, competitors are not satisfied with the prices, the market participants have to start negotiations. Only in case, that these negotiations fail, the national regulator ComCom is requested to take action. The

²² Whereas the arrow does not implicate a causal mechanism; the arrow merely indicates a logical implementation, saying, where Y is given, there is also X (Schneider/Wagemann 2009:390).

²³ Consistency values of the other conditions for the outcome high regulatory innovativeness are as following: GDP/capita 0,80; cable 0,70; size 0,44; group 0,81.

regulator assesses the prices and fixes new prices, in case that there are legal infringements. Therefore, the role of the regulator in Switzerland seems to be rather responsive in nature, but formatting market structure in advance.

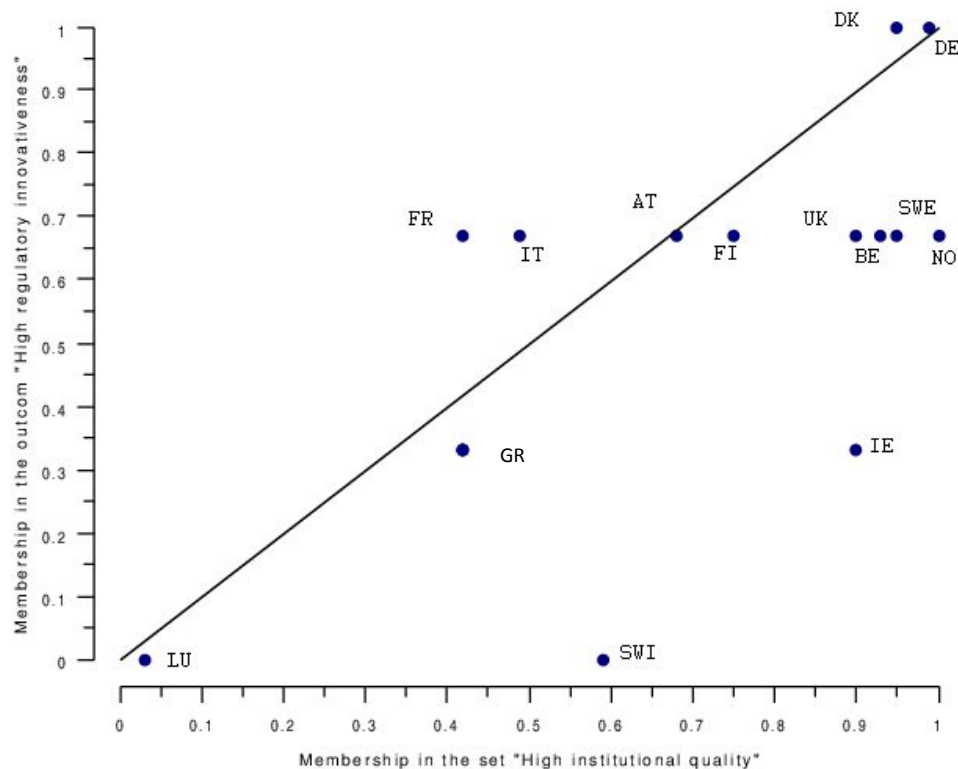
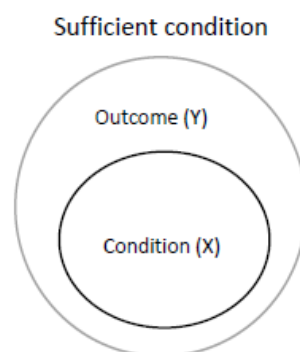


Figure 2. Necessity of a High Institutional Quality of a national regulator for a high level of Regulatory innovativeness

In contrast, **sufficient** conditions imply the occurrence of the outcome whenever the condition is present ($X \rightarrow Y$, if Y, then Y; see Schneider/Wagemann 2007:32). Another Venn-diagram shows this set-theoretic constellation:



Following Schneider/Wagemann 2007:36

The analysis of sufficient conditions is performed by the Quine McClusky truth table algorithm (Schneider/Wagemann 2012:104ff). Truth table rows, which are consistently sufficient for the outcome, are minimized in favor of more scarce solutions. The row of a truth table is sufficient for the outcome, in case that the membership of each case in the respective ideal type is equal to or lower than its

membership in the outcome set. For the outcome 1 “High regulatory innovativeness”, the analysis of sufficient conditions, the consistency threshold for sufficient rows of 0.9²⁴ is applied.

The most parsimonious solution can be found in table 6. In the first conjunction the presence of the four conditions (Regulator with high institutional quality and group member at IRG/ERG, active in a wealthy country with high cable coverage) is designated as sufficient for the outcome “high degree of regulatory innovativeness” (table 6, column left). This conjunction covers six cases (Denmark, Austria, Belgium, the United Kingdom, Sweden and Finland). Three EU member states (Denmark, Germany and United Kingdom) outline, that a high degree of regulatory innovativeness is explained again by a conjunctural path of conditions (table 6, mid-column): Big-sized regulator with high institutional quality, group membership in ERG and IRG, active in a wealthy country. Both solution paths fit very well with assumptions, made in diffusion literature.

Measures of fit	Sufficient	OR	Conditions	Outcome
	High institutional quality AND Group membership ERG/IRG AND Wealthy country AND High cable coverage		High institutional quality AND Big size regulator AND Group membership ERG/IRG AND Wealthy Country	High degree of regulatory innovativeness
Raw Coverage	0.50		0.33	
Unique Coverage	0.22		0.05	
Consistency	0.99		0.99	
Cases Explained	Denmark, Austria, Belgium, UK, Sweden, Finland		Denmark, Germany, UK	

Table 6. Minimal Solution of Sufficient Conditions for the Outcome 1 “High Degree of Regulatory Innovativeness in EU telecommunication”; Total solution coverage is 0.55; total solution consistency is 0.99.

For the minimization of sufficient conditions for *low* regulatory innovativeness, again the consistency threshold of 0.9 is applied. The most parsimonious solution makes simplifying assumptions about four rows in the truth table (table 7). A low degree of regulatory innovativeness among EU national regulators is explained by four combinations.

The first includes small-sized regulators with a low institutional quality, member in the groups ERG and IRG, active in a non-wealthy country. The four cases explained are Portugal, Spain, Italy and Greece.

²⁴ Schneider/Wagemann (2012) recommend a minimum consistency threshold of 0.8.

Relative high raw coverage (0.35) confirms the importance of this path. With the exemption of group membership, this is fully in line with assumptions derived from theoretical literature.

The second combination includes a small regulator with low institutional quality and ERG and IRG group membership, active in a wealthy country with high cable coverage (the Netherlands). The third combination describes a case, where a small regulator with low institutional quality, which is not a member in the two networks, acting in a wealthy country with low cable coverage. The case explained is Luxembourg. Fourth conjunction includes a big-sized regulator, showing high institutional quality, while being not a member in both networks, active in a wealthy country with high cable coverage. The case explained is Switzerland.

A common feature of all cases explained is a low institutional quality, which underlines the importance of this condition. An exemption is Switzerland, showing a high institutional quality. However, as outlined before, this country employs an ex-post regulatory approach, which explains a big share of a late adoption approach of regulatory means. Interesting is also the combination wealthy countries, lacking a membership in the expert groups ERG and IRG, leading to a low degree of regulatory innovativeness. A shortage in mutual interaction with other regulators may explain the rather late adoption attitude of these regulators.

Measures of fit	Sufficient Conditions				Outcome	
	Low institutional quality AND Small size regulator AND Group membership ERG/IRG AND Non-Wealthy country	OR	Low institutional quality AND Small size regulators AND No Group membership ERG/IRG AND Wealthy Country AND High cable coverage	OR	Low institutional quality AND Big size regulator AND No group membership ERG/IRG AND Wealthy Country AND High cable coverage	Low degree of regulatory innovativeness
Raw Coverage	0.35		0.12		0.17	0.15
Unique Coverage	0.26		0.06		0.08	0.09
Consistency	0.92		1.00		0.96	1.00
Cases Explained	Portugal, Greece, Spain, Italy		Netherlands		Luxembourg	Switzerland

Table 7. Minimal Solution of Sufficient Conditions for the Outcome 0 “Low High Degree of Regulatory Innovativeness in EU telecommunication”; Total solution coverage is 0.64; total solution consistency is 0.96.

5. Results for Groups of Innovators

Pioneers

Based on the introduction dates of three different access regulations, the two regulators in Denmark and Germany have been identified as pioneers. According to former literature it is expected that if the identified influencing conditions are present, the likelihood that a national regulator adopts a regulatory mean earlier increases. Solely for cable coverage this is not entirely clear. The respective regulators in Denmark and Germany achieve the outcome high degree of regulatory innovativeness under the same setting. Both regulators have been categorized as set members, showing a high institutional quality, are well-staffed and are long-term members in both, ERG and IRG. Moreover, they are active in a wealthy country.

However, Denmark is also member of another solution path, leading to a high degree of regulatory innovativeness. Its membership as a regulator with high institutional quality, long-term group membership in ERG and IRG, acting in a relative wealthy country, includes also the condition of high cable coverage. Therewith for a very high degree of regulatory innovativeness there seems to exist some crucial elements such as high institutional quality or a regulator, active in expert networks, operating in a relative wealthy country. In terms of size of the regulator and cable coverage different settings lead to “success”.

Early Majority

According to the grouping in chapter 3.2, Finland, France, Austria, Sweden, Belgium, the United Kingdom and Norway are designated as Early Adopters and therewith showing a quite high level of regulatory innovativeness.

Particular interesting is the “North Cluster” Sweden, Finland and Denmark (in the role of a Pioneer) as innovatively leading. These countries are members of the set, covering wealthy countries, a big sized regulator, which acts in a high institutional quality environment and which is member of both ERG and IRG. This matches well with key assumptions on imitation and similarity made in diffusion theory. In terms of imitation, it has been stated that the likelihood of a national regulator adopting a regulatory policy increases when its nearest bigger neighbor adopts the same policy. Denmark in its role of a “Pioneer” employs on average 271 people at its regulatory institution in the observed time period. Its smaller neighbors Sweden (162 employees) and Finland (137 employees) follow typically quickly in the adoption of regulatory policies.²⁵ Another underlying rationale for early or late adoption of a regulatory policy may be the similarity of countries or national regulators. Institutional similarities are outlined to have an effect on the spread of policies and therefore on the point of adoption. As pointed out by Shipan/Volden (2014), similar-state adoption

²⁵ Exception is an introduction case of Finland, where it introduced LLU first. However, this is a special case, since it was the ministry, not the national regulator, adopting the mean.

is also consistent with learning-based diffusion. For the “North Cluster” Finland, Denmark and Sweden, showing similar or same characteristics in terms of market conditions and characteristics of the regulator, this seems to be an important part of the explanation of early innovation spreading.

Interesting is also the case of Norway, which cannot be explained by the comparative method used. Compared to all other NRAs in the sample, the regulator in Norway shows the highest institutional quality by far (score 0.74). In the study of Waverman/Koutroumpis (2011), the Norwegian regulator even ranked first globally in terms of its performance. Norway is not a full EU-member state and therefore no full member of the European Regulators Group. This may reduce the number of strong ties and potentially the peer pressure to innovate. It seems that the Norwegian regulator replied closely to market evolvments rather than setting individual standards. As outlined earlier for the case of WLR, it was not the national regulator, introducing the access product first. It was the Incumbent, offering access on a voluntary basis. Therefore, it may also be beneficiary for high quality regulatory governance to closely respond to evolving national market characteristics, rather than being particular active in introducing new means itself. In the literature similar arguments can be found. For example, Stelzer (2006) states that market forces and not regulatory agencies should choose superior technologies, Cave (2006) argues in favor of increased reliance on market-mechanism tools and Booth (2006) insists that regulators should target on the competitive process rather than attempting to design a speculative outcome of perfect competition.

The high regulatory innovativeness of Austria, United Kingdom and Belgium has been explained by the combination of wealthy countries with high cable coverage, a regulator showing high institutional quality and is member of ERG and IRG. In geographical terms, their similarities in terms of market and regulator characteristics, may lead to quick similar-state adoption of the big-sized innovative neighbor Germany.

It is interesting to see, that the European level intervenes, when a critical number of member states already adopted the respective regulatory product. According to the grouping of potential adopters on the diffusion curve (table 4) and relevant literature, the typical distribution on the diffusion curve covers 16% of Pioneers, 34% of Early Majority, 34% of Late Majority and again 16% of the Laggards. In the case of the earliest mean, Local Loop Unbundling, the according regulation was published in December 2000. At this time, already nine out of seventeen countries had adopted LLU. In the case of Wholesale Line Rental, which was included in a directive in March 2002, four out of seventeen countries had adopted the mean before. Lastly, for Bitstream Access, the ERG published their Common Position in April 2004, nine countries introduced BSA earlier. Translated to the diffusion curve and the according adopter categories, it can be seen, that the EU level intervenes, when an (smaller or bigger) group of Early Adopters already introduced the respective product.

Late Majority

Starting by the initial grouping, the Late Majority encompasses the Netherlands, Portugal, Greece, Spain, Italy and Ireland.

In total four explanatory paths cover a rather low regulatory innovativeness. With non-wealthy countries, small sized regulator, acting in a rather low institutional quality environment and which is member of ERG and IRG, the cases of Portugal, Spain, Greece and Italy are explained. The quite high coverage (0.36) shows the relative importance of this path. Reflected by diffusion literature, typically less wealthy countries with low-staffed regulators, showing a low level of social ties, adopt new (regulatory) products later.

The second path covers wealthy countries, with high cable coverage, small-sized regulator, a low institutional regulatory quality environment, where the regulator is member of only one regulatory network. The Netherlands is sole member, explained by this path. The national regulator is member in the ERG, but not of IRG for the time period observed. This may point to weaker social ties. The Netherlands are in fact a country with very good conditions for facilities-based competition (de Bijl, Peitz 2008; i.e. showing by far the highest cable coverage among the included cases). This may explain the relative late introduction of regulatory access means by the national regulator. Due a relatively high level of inter-network competition the introduction of means, mandating easier access to given networks is not so urgent.

Across all paths of sufficient conditions for a low degree of regulatory innovativeness, the condition of low institutional quality of a national regulator prevails.²⁶ The relative poor institutional quality in contrast to the earlier adopting regulators is in line with existing diffusion literature (e.g. Rogers 1995).

The group of Late Majority seems to be particularly guided by the European level. In case of LLU, the heaviest EU-level intervention took place. The EU Regulation applied from 31 December 2000 on. The majority of the group of Late Adopters, which can be explained by the comparative method (regulators in Greece, the Netherlands, Spain and Portugal) adopted LLU in the following year 2001 (see table 4 in the appendix). It remains unclear, if the access product would have been introduced by the respective national regulators in the same time horizon without the regulatory activities on the European level.

Laggards

According to the technique applied in chapter 4, Luxembourg and Switzerland were identified as “Laggards” in terms of introduction of new regulatory access products.

Reasons for a late adoption of access obligations seem very country-specific. Whereas Luxembourg is an early EU member state, Switzerland is neither an EU

²⁶ Under exemption of Switzerland for the already outlined reasons.

member nor a member of the European Economic Area. But it is part of the single market. The countries regulator may therefore face reduced social bonds and peer pressure by its European colleagues. Moreover, the already outlined ex post approach of regulation in Switzerland is an important part of the explanation of late adoption.

Interestingly, the two countries have a high relative wealth in common. In fact, they range among the top three countries in terms of their GDP per capita. This is not in line with the assumption, which can typically found in diffusion literature, namely, that laggards typically have only few financial resources.

Nevertheless, the results for the case of Luxembourg are in line with theory in terms of institutional quality. The regulator in Luxembourg shows the poorest institutional quality, compared to all other national regulators included in the sample. The regulator in Luxembourg is also lowest in terms of resource availability, compared to all other NRAs included in the sample (Waverman/Koutroumpis 2011). Therefore, even if this national regulator is member of two networks, the institution seems to be poorly staffed and not well equipped with financial resources. This may explain at least partly the late adoption of the three access products, compared to other regulators.

6. Conclusion

The paper explores influencing factors on the innovativeness of national telecommunication regulators across Europe. The choice of 17 EU countries and their respective regulators includes national states with similar historical and institutional background to ensure comparability. Goal was to gain exploratory insights into the ways in which key access products spread across Europe and to identify the role of related actors. Even if theories based on driving forces of adoption could explain some cases, they could not explain all. With five simple conditions, an epistemic element has to be integrated. For complete explanation, these conditions are seen as first attempt to gain insights of crucial factors of influence on regulatory innovativeness.

Using fuzzy set qualitative comparative analysis is a novel approach for the field that addressed the given lack in the literature. The method accounts for conjunctural causality of the phenomenon. The application of data in this context enriches the field's knowledge because it helps to assess the influence of crucial factors on regulatory innovativeness. Therewith, it opens up avenues for new theories on regulatory innovativeness and its causes. Nevertheless, the method has limitations. The applied approach offers limited scope in dealing with dynamic factors (Schneider/Wagemann 2010:385). To display change, the inclusion of observations at multiple points in time is required, which inspired the development of "time-series" QCA (Hino 2009). However, this makes solution formulas much more complex (Ragin/Strand 2008) and the data collection process even more demanding

(Lambach et al 2015). Since this paper represents a primary exploration of the topic and fundamental influences should be identified, dynamic factors are left aside.

The regulators in Denmark, Sweden and Finland show a high degree of regulatory innovativeness. They have in common, that they are well-staffed, show a high institutional quality and are group members of both, ERG and IRG. Also, they are positioned in a relatively wealthy country, where average cable coverage is rather low. This matches well with assumptions made in diffusion theory. This institutional similarity may lead to economic and political linkages between the countries, encouraging incentives for regulatory competition and intentions to gain according first-mover-advantages. Potential mutual learning activities may be encouraged due to the geographical proximity.

Moreover, the Danish regulator, together with the regulator in Germany, is identified as Pioneer, being particular early in introducing new regulatory products, compared to all other regulators in the sample. Both regulators show a high institutional quality, are well-staffed and long-term group members of ERG and IRG. They are also active in relatively wealthy countries. In total, the characteristics of the national regulator seem to be decisive for the early introduction of new regulatory means.

On the other side of the diffusion curve, regulators in Luxembourg and Greece are identified as Laggards, introducing a regulatory mean typically later than other regulators of the sample. Also the regulators in Spain, Portugal, the Netherlands and Switzerland show a particular low level of innovativeness. With exclusion of Switzerland, all six regulators show a relative poor institutional quality. The case of Switzerland differs, since there a regulatory system with an ex-post focus prevails.

In general, a large number of cases validate the explanation that predicts that internal budget pressure is rather a characteristic of the later adopting countries (not of the laggards) and not of those, introducing new access products early.

In terms of cable coverage, there is often a high cable coverage given in countries, introducing access obligations early. Therefore the assumption that a low level of alternative infrastructure should lead per se to an earlier introduction of access obligations to enhance at least service-based competition does not hold. Possibly, in countries where no alternative operator is in place and the market is more reliant on the incumbent, the regulator might face higher barriers to introduce increased (service-based) competition (positive theory of regulation/regulatory capture at the beginning of the market opening process).

Interesting is also the membership of a national regulator in regulatory networks and therefore the condition of involvement in mutual exchange with colleges and learning possibilities. Whereas in the group of Pioneers, all regulators are members of the IRG and the ERG, Early Adopters fulfill not always this condition. This is also the case for Laggards. The impact of social ties, encouraged through long-term membership in two regulatory networks seems to play a role, but not the most decisive one for a high degree of regulatory innovativeness of a national regulator.

The European level intervened with varying intensity in term of access regulation until 2009. Whereas WLR has been considered in a Directive as potential wholesale remedy in 2002, BSA has been officially addressed by a common position of the ERG in 2004. LLU has been obligated by EU Regulation end of 2000. In case of LLU, the Late Majority countries all adopted the regulatory mean immediately afterwards, i.e. in the first four month of 2001. This may point to the assumption that these national regulators took action only on heavy demand of the European level.

The European level intervened at different positions on the diffusion curve. Translated to the diffusion curve and the according adopter categories, it can be seen, that the EU level intervenes, when an (smaller or bigger) group of Early Adopters already introduced the respective product.

Whereas most of European regulatory approaches aim at leveling the playing field between member states and even achieving a harmonization of national policies (Tews et al 2003), telecommunication regulation on the national level remain to a certain extent diversified and may benefit regulatory competition. It can be assumed, if taken the idea of 'policing power' of national regulators seriously, that the two regulators in Denmark and Germany served as innovative rule-setters for the European level as well.

In sum, there are varying paths to attain a high level of regulatory innovativeness on the national level in the sector of telecommunication. Altogether, political decision-makers should steadily encourage a high institutional quality of a regulator by ensuring sufficient independence, budget and manpower.

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Appendix

Country	Institutional quality of the National Telco Regulator (Index Koutroumpis/Waverman 2009)	Size of the National Telco Regulator (in terms of employees with regulatory function, mean over the years 1999-2009 where available, ECTA scorecard, NRA annual reports)	Group membership Regulatory Networks ERG/IRG (Email reply)	GDP per capita (mean over the years 1996-2009, OECD data)	Cable modem Internet subscriptions per capita*100 (mean over the years 1999-2009, ITU and OECD data)
AT	.61	58	1	32457	4
BE	.66	27	1	30922	6
DK	.67	271	1	31841	6
FI	.62	137	1	28625	2
FR	.58	149	0	29369	1
DE	.71	239	1	30755	1
GR	.58	118	1	22500	0
IE	.65	77	1	34640	1
IT	.59	37	1	27654	0
LU	.49	223	1	63191	1
NL	.58	88	0	34155	8
NO	.74	163	0	45354	3
PT	.58	138	1	20902	4
ES	.58	105	1	25919	2
SWE	.67	162	1	30383	3
SWI	.60	301	0	36173	5
UK	.65	641	1	30788	4

Table 1. Raw data on the Interval Scaled Conditions, Characteristics of Qualitative Conditions and Sources

Intervention EU level: LLU 12_2000 WLR 03_2002 BSA 04_2004

No. of countries where mean already adopted LLU 9/17 WLR 4/17 BSA 9/17

LLU				WLR				BSA						
Order	Country	Year_Month	AC	Order	Country	Year_Month	AC	Order	Country	Year_Month	AC	Country	Adopter categories	AC
1	Finland	1997_12	1	1	Denmark	1999_12	1	1	Austria	2000_3	1	Austria	221	2
2	Germany	1998_4	1	2	France	2000_1	1	2	Ireland	2000_4	1	Belgium	232	2
3	Denmark	1998_12	1	3	Germany	2001_3	1	3	Spain	2000_8	1	Denmark	112	1
4	Austria	1999_07	2	4	Norway	2001_10	2	4	Portugal	2000_11	2	Finland	143	3
5	UK	1999_11	2	5	UK	2002_8	2	5	Belgium	2000_12	2	France	212	2
6	Italy	2000_3	2	6	Ireland	2003_6	2	8	Denmark	2000_12	2	Germany	113	1
7	France	2000_11	2	7	Austria	2004_12	2	6	Norway	2001_2	2	Greece	334	3
8	Belgium	2000_12	2	8	Sweden	2005_2	2	7	France	2001_6	2	Ireland	421	3
9	Sweden	2000_12	2	9	Portugal	2005_6	3	9	Netherlands	2003_5	2	Italy	234	3
10	Greece	2001_1	3	10	Italy	2006_2	3	10	UK	2004_5	3	Luxembourg	434	4
11	Netherlands	2001_1	3	11	Belgium	2006_6	3	11	Finland	2004_9	3	Netherlands	332	3
12	Spain	2001_1	3	12	Greece	2006_12	3	12	Sweden	2004_11	3	Norway	322	2
13	Norway	2001_2	3	13	Netherlands	2007_1	3	13	Germany	2006_9	3	Portugal	332	3
14	Portugal	2001_3	3	14	Luxembourg	2007_2	3	14	Greece	2006_12	3	Spain	341	3
15	Ireland	2001_4	4	15	Switzerland	2007_4	4	15	Italy	2006_12	4	Sweden	223	2
16	Luxembourg	2001_11	4	16	Spain	2008	12	16	Switzerland	2007_04	4	Switzerland	444	4
17	Switzerland	2007_4	4	17	Finland	0	0	17	Luxembourg	2014_12	4	UK	223	2
AC=Adopter Category; 1= Pioneer, 2=Early Majority, 3=Late Majority, 4=Laggards														
Year_Month=Month, when access obligation has been published by national regulator														

Country	Adopter categories	Membership
Denmark	112	1
Germany	113	1
Finland	143	0.67
France	212	0.67
Austria	221	0.67
Sweden	223	0.67
UK	223	0.67
Belgium	232	0.67
Norway	322	0.67
Netherlands	332	0.33
Italy	234	0.33
Greece	334	0.33
Spain	341	0.33
Ireland	421	0.33
Luxembourg	434	0
Switzerland	444	0

Table 8. Grouping of countries/ NRAs by their introduction date of access products and qualitative calibration of set membership “Innovative Regulator”